



PIER Energy-Related Environmental Research

Environmental Impacts of Energy Generation, Distribution and Use

Environmental Effects of Cooling Water Intake Structures

Contract #: 500-04-025

Contractor: San Jose State University Foundation, Moss Landing Marine Labs

Contract Amount: \$1,499,800.00

Contractor Project Manager: Lara Ferry-Graham

Commission Project Manager: Melinda Dorin

The Issue

A significant portion of California's generation capacity, approximately 45 percent, is represented by facilities located along the state's coast and estuaries that use once-through cooling technology. This cooling technology requires the withdrawal of significant amounts of water (~17 billion gallons per day) that is passed by a condenser and then discharged back into a waterbody. Although some of these facilities have been operating since the 1950s, scientific understanding of the ecological effects of the use of once-through cooling is quite limited. The impacts of cooling water withdrawals are characterized as *entrainment*, where small aquatic organisms are carried by the cooling water into the power plant and killed by heat and as *impingement*, where the cooling water intake traps larger organisms against the intake screens. Discharge of cooling water heated to levels significantly above temperatures of the receiving waterbody can also alter aquatic ecosystems.



Many coastal power plants, such as this one at Moss Landing, use once-through cooling.

Project Description

The Water Intake Environmental Research (WISER) Program was created at Moss Landing Marine Labs with funding from the California Energy Commission Public Interest Energy Research (PIER) program. The program is charged with identifying, funding, and managing research that will provide the information and tools necessary within the regulatory process to ensure accurate assessments of impacts of once-through cooling effects on aquatic life and their mitigation. To identify critical public interest research areas, a workshop consisting of academics, consultants, government agencies, and industry representatives was held in April 2005. The specific research tasks identified were to:

1. Determine how to better identify and enumerate species that are entrained (or otherwise affected).
2. Determine which are the "best" metrics to use to measure an impact.
3. Develop long-term datasets for understanding coastal power plant ecological effects.
4. Determine the area affected using modern oceanographic tools (such as computational fluid dynamics).
5. Identify viable entrainment reduction technologies for California once-through cooling plants and

identify and quantify their benefits.

6. Establish how to monitor mitigation efforts and the criteria for success.

WISER responded with a request for proposals and additional funding opportunities. Currently funded projects include the following (the workshop goal from the list above follows in parentheses):

1. Molecular Identification and Enumeration of Invertebrate Larvae Potentially Entrained by Once-through Cooling in Morro Bay and Elkhorn Slough, California *by Jon Geller, Moss Landing Marine Labs* (1)
2. Life History Parameters of Common Nearshore Marine Fishes *by Charles Mitchell and collaborators, MBC Environmental* (2)
3. Uncertainty and Efficacy in Entrainment Impact Models *by Pete Raimondi, University of California, Santa Cruz* (2)
4. Examination of Life History Data for Estimating Impacts, Potential Indicator Species for Monitoring for Impacts, Cumulative Impacts, and the Basis for Mitigation of Impacts *by Liz Strange and David Allen, Stratus Consulting* (2, 6)
5. The Ichthyoplankton of King Harbor, Redondo Beach, California 1974–2006 *by Daniel Pondella and collaborators, Occidental College* (3)
6. Improving Assessment of Entrainment Impacts through Models of Coastal and Estuarine Withdrawal Zones *by Jon Largier, University of California, Davis* (4)
7. Bright Vibrating Screens: Increasing the Detectability of Fish Screens *by Joseph Cech and M. Levent Kavvas, University of California, Davis* (5)

PIER Program Objectives and Anticipated Benefits for California

This project offers numerous benefits and meets the following PIER program objectives:

- **Improving the environmental costs/risk of California's electricity.** All of the projects conducted under this work will provide crucial information that will enable California's decision makers to identify and address environmental problems associated with the state's once-through cooling technologies. This work will affect power generation facilities throughout the state and at California's coastal power plants from which water is drawn for once-through cooling.

The project also meets the PIER's goals to conduct research and development activities that will advance science or technology not adequately addressed by the competitive and regulated markets that evaluate and resolve environmental effects of energy delivery in California and provide clearly identifiable benefits to California's ratepayers.

Final Report

PIER-EA staff intend to post all the final project reports on the Energy Commission website as the research is completed (fall 2008 for the program final report) and will list the website links here. All reports are also posted at the Water Intake Structure Environmental Research (WISER) website, at <http://ecomorphology.mlml.calstate.edu/WISER.html>.

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